NRI research highlights

NATIONAL RESEARCH INITIATIVE COMPETITIVE GRANTS PROGRAM

Natural Antimicrobials Inhibit Food Surface Contamination

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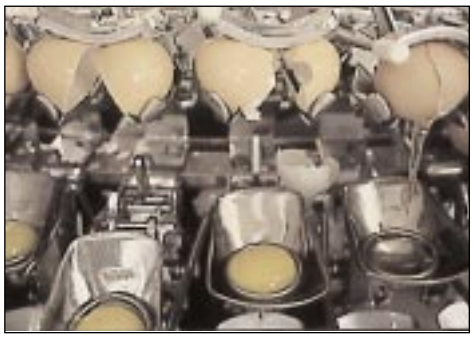
Foodborne disease is often spread by cross-contamination between foods and unclean surfaces – including packaging materials, holding vessels or tanks, and conveying equipment. Microorganisms that cause disease and food spoilage can adhere to these food contact surfaces and become much more resistant to sanitizers than when they are not adhered.

Together with entrapped organic matter, adhered bacteria form what is called a biofilm, which can resist the action of antimicrobials. Bacterial adhesion to inert surfaces is of great public health concern, as it may result in "biofouling" and act as a likely source of contamination.

In a food processing facility, bacterial adhesion to food and food contact surfaces is significant in that it may transmit disease or cause product spoilage losses.

Listeria monocytogenes is a microorganism that has recently received attention among food processors and consumers because of its ability to cause listeriosis, a potentially fatal foodborne illness. Perhaps the most threatening characteristic of *Listeria monocytogenes* is its ability to survive and grow in raw and processed foods held under refrigeration temperatures.

This bacterium has also been shown to adhere to food contact surfaces and establish biofilms that are resistant to sanitizers. Preventing cross-contamination of finished processed products by either contaminated raw foods or food contact surfaces is of paramount importance in controlling *Listeria*.



MARK DAESCHEL

EQUIPMENT LIKE THIS AUTOMATED EGG-SEPARATING MECHANISM NEEDS FREQUENT CLEANING AND SANITIZING TO PREVENT BUILD-UP OF BACTERIA ON THE METAL SURFACES.

NOVEL APPROACH

USDA's National Research Initiative (NRI) Competitive Grants Program is supporting basic research at Oregon State University to control adhered bacteria and formation of biofilms. OSU researchers are trying a novel approach

Nisin and lysozyme are attractive to food processors and consumers.

to inhibit the initial adhesion of microbial contaminants by applying an antimicrobial agent to food contact surfaces, as opposed to trying to remove them once they are adhered.

The hypothesis is that by maintaining antimicrobial activity at the food contact surface, sensitive bacterial cells or spores that attempt to adhere are killed. The researchers have already demonstrated the validity of the hypothesis by observing that the protein antimicrobial nisin can adsorb to surfaces, maintain activity, and kill adhered cells of *Listeria monocytogenes*. Nisin is a naturally occurring protein that is non-toxic to people and is categorized as a consumer-friendly food preservative.

Nisin is synthesized and secreted by a dairy microorganism, *Lactococcus lactis*. It inhibits Gram-positive bacteria, including the foodborne pathogens *Clostridium botulinum* and *L. monocytogenes*. Nisin is believed to kill sensitive bacteria by destabilizing the cell membrane with subsequent lysis. Nisin is also effective in inhibiting spores.

OREGON AGRICULTURAL EXPERIMENT STATION

IN A FLUID MILK PLANT, TANK SURFACES ARE A FAVORABLE ENVIRONMENT FOR BACTERIAL GROWTH. SURFACE TREATMENT WITH NISIN CAN INHIBIT THE ATTACHMENT OF BACTERIA.

The researchers are also using a second antimicrobial protein – hen egg-white lysozyme – that is naturally present in chicken eggs. As with nisin, Gram-positive bacteria are most susceptible to lysozyme, which has been thoroughly investigated for use in the food and pharmaceutical industries.

Lysozyme is used to extend the shelf life of a variety of processed foods, including pickles, dairy foods, and meats. A petition to the Food and Drug Administration for affirmation of lysozyme, an enzymatic agent that kills bacteria by breaking down their cell walls, is under review.

IMPACT

Because of their natural origin and lack of toxicity, the antimicrobial agents nisin and lysozyme are attractive to food processors and consumers.

The OSU researchers have shown that pretreating food contact surfaces with protein-based preservatives will inhibit growth of microorganisms that may cause foodborne contamination in both the food processing and food service sectors.

Apparent applications exist in related areas, such as medicine. Researchers are exploring adsorbing protein antimicrobials onto medical devices such as endotracheal tubes, which are prone to microbial colonization.

The research reported in this factsheet was sponsored by the Improving Human Nutrition for Optimal Health Program of the Nutrition, Food Safety, and Health Division of the National Research Initiative Competitive Grants Program. To be placed on the mailing list for this publication or to receive additional information, please contact the NRI (202/401-5022 or NRICGP@reeusda.gov). The factsheet also is accessible via the NRI section of the Cooperative State Research, Education, and Extension Service website (http://www.reeusda.gov/nri).